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National
Voluntary
Laboratory
Accreditation
Program

Acoustical Testing Services

Paul R. Martin
Richard J. Peppin

NIST HANDBOOK 150-8

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Technology Administration
National Institute of Standards
and Technology

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[2] Some elements at Boulder, CO 80303.

NIST HANDBOOK 150-8

National Voluntary Laboratory Accreditation Program

Acoustical Testing Services

Paul R. Martin, NIST
Richard J. Peppin, P.E., Contractor
Agreement # 45NANB 0K6321

December 1994

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PREFACE

NIST Handbook 150-8 presents the technical requirements of the National Voluntary Laboratory Accreditation Program (NVLAP) for accreditation of Acoustical Testing Services laboratories. It is intended for information and use by staff of accredited laboratories, those laboratories seeking accreditation, other laboratory accreditation systems, users of laboratory services, and others needing information on the accreditation requirements. Laboratory accreditation for acoustical testing was established in 1982.

This publication supplements NIST Handbook 150, *NVLAP Procedures and General Requirements*, which contains Part 285 of Title 15 of the U.S. Code of Federal Regulations (CFR) plus all general NVLAP procedures, criteria, and policies. The criteria in NIST Handbook 150 encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987). Handbook 150-8 contains information that is specific to the Acoustical Testing Services program and does not duplicate information contained in the *NVLAP Procedures and General Requirements*. It is organized to cross-reference with Handbook 150; for example, Section 285.3 of Handbook 150 presents the description and goal of NVLAP, whereas Section 285.3 of Handbook 150-8 presents a description of the Acoustical Testing Services program. Where there is no material specific to the field of accreditation, the section number is omitted.

Any questions or comments on this handbook should be submitted to the National Institute of Standards and Technology/NVLAP, Building 411, Room A162, Gaithersburg, MD 20899; phone (301) 975-4016; FAX (301) 926-2884.

ACKNOWLEDGMENTS

The authors acknowledge the contributions of the NVLAP staff in preparing the operational information and accreditation requirements contained in this handbook. Recognition is also given to the developers of the original Acoustical Testing Services program handbook and to the NVLAP assessors for their work in performing the on-site assessments.

Special thanks are extended to Vanda White and Channing Monti who edited the handbook for publication.

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SUMMARY

Any laboratory (including commercial, manufacturer, university, or federal, state, or local government laboratory) that tests in accordance with standard acoustical test methods may apply for NVLAP accreditation under the Acoustical Testing Services program. These test methods may be developed by a trade, professional, governmental, or standards-writing organizations, and relate to this program. Accreditation will be granted to a laboratory that satisfactorily fulfills the conditions for accreditation defined in NIST Handbook 150, *NVLAP Procedures and General Requirements*, which contains Title 15, Part 285 of the Code of Federal Regulations. These conditions include satisfactory performance in selected proficiency testing as required, and fulfilling the on-site assessment requirements, including resolution of identified deficiencies. The names of NVLAP-accredited laboratories are published in the NVLAP annual directory and other media to which information is regularly provided.

Testing services covered: Various test methods covering sound absorption, acoustic impedance, sound attenuation, vibration, sound power levels, emitted noise and hearing protection. Other methods may be included if appropriate.

Period of accreditation: One year, renewable annually

On-Site assessment: Visit by a technical expert to determine compliance with the NVLAP accreditation criteria before initial accreditation and every 2 years thereafter. Monitoring visits as required.

Assessors: Technical experts with experience in the appropriate field(s) of testing.

Proficiency testing: NVLAP will periodically ask accredited laboratories to participate in interlaboratory proficiency tests on acoustical materials or other items. NVLAP does not have in place a regularly scheduled proficiency testing program for acoustical testing; however, proficiency testing rounds may be conducted as needed to evaluate laboratory proficiency.

Granting Accreditation: Based upon satisfactory on-site assessment and resolution of deficiencies, proficiency testing, and technical evaluation of applicable laboratory information.

Fees: Payments are required as listed on the NVLAP fee schedule, including the administrative/technical support fee, on-site assessment fee, proficiency testing fee, and test method fee.

Sec. 285.1 Purpose

The purpose of this handbook is to set out procedures and technical requirements for NVLAP accreditation of acoustical testing laboratories. It complements and supplements the NVLAP programmatic procedures and general requirements found in NIST Handbook 150. The interpretive comments and additional requirements contained in this handbook make the general NVLAP criteria specifically applicable to the Acoustical Testing Services program. The quality system requirements are designed to comply with the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002.

Sec. 285.2 Organization of procedures

(a) The procedures described in this handbook are organized to cross-reference with NIST Handbook 150, *NVLAP Procedures and General Requirements*.

(b) In addition, the handbook contains six appendices:

(1) Appendix A provides examples of a Certificate of Accreditation and a Scope of Accreditation for the Acoustical Testing Services program;

(2) Appendix B provides the General Operations Checklist, which NVLAP assessors use during an on-site technical assessment to evaluate a laboratory's ability to conduct testing in general;

(3) Appendix C provides the Test Method Review Sheets, which NVLAP assessors use during an on-site technical assessment of a laboratory that performs acoustical testing;

(4) Appendix D contains Calibration Requirements;

(5) Appendix E contains an example of a NVLAP Interlaboratory Proficiency Test; and

(6) Appendix F contains the Test Method Selection List.

Sec. 285.3 Description of Acoustical Testing Services accreditation program

Accreditation is available for selected test methods in the areas of sound absorption, impedance, attenuation, vibration, power levels, emitted sound and hearing protection, among others. This accreditation program is designed to satisfy the requirements of contractors, state and local governments, and federal agencies specifying accreditation for laboratories that perform testing for compliance to acoustical design specifications and performance testing of acoustical materials and noise protection devices.

The present test methods for which a laboratory may seek accreditation are listed in Appendix F. Other test methods may be added to the program upon request, if they are found to be appropriate by NVLAP.

Sec. 285.4 References

The following documents are referenced or cited in this handbook:

(a) ISO/IEC Guide 25, *General Requirements for the Competence of Calibration and Testing Laboratories*; available from:

American National Standards Institute (ANSI)
11 West 42 Street, 13th Floor
New York, NY 10036

Order Phone: (212) 642-4900
Order FAX: (212) 302-1286;

(b) ISO 9002, *Quality Systems—Model for Quality Assurance in Production and Installation*; available from ANSI (see Sec. 285.4(a));

(c) ISO 3745, *Acoustics—Determination of Sound Power Levels of Noise Sources - Precision Methods for Anechoic and Semi-Anechoic Rooms*; available from ANSI;

(d) ANSI S12.31-1990, *Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms*; available from ANSI;

(e) ASTM C634-89, *Standard Terminology Relating to Environmental Acoustics*; available from:

ASTM
1916 Race Street
Philadelphia, PA 19103

Order Phone: (215) 299-5400
Order Fax: (215) 977-9679;

(f) NCSL (National Conference of Standards Laboratories) Recommended Practice #7, *Laboratory Design*, July 25, 1993; available from:

NCSL
1800 30th Street, Suite 305B
Boulder, CO 80301

Phone: (303) 440-3339
Fax: (303) 440-3384;

(g) NIST Handbook 150, *NVLAP Procedures and General Requirements*; available from:

NIST/NVLAP
Building 411, Room A162
Gaithersburg, MD 20899

Phone: (301) 975-4016
FAX: (301) 926-2884.

Sec. 285.5 Definitions

Acoustical material: Any material considered in terms of its acoustical properties. Commonly and especially, a material designed to absorb sound.

Acoustics: The scientific study of sound, specifically of its generation, transmission, absorption and control.

Anechoic room: A test room whose surfaces absorb essentially all of the incident sound energy over the frequency range of interest, thereby affording free-field conditions over the measurement surface.

Critical element: A compilation of summary statements of the key provisions of a standard test method that guides assessors in applying a common objective assessment of a laboratory's ability to conduct tests.

Quality assurance: All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Quality control: The operational techniques and activities that are used to fulfill requirements for quality.

Reverberation room: A test room, meeting the standard requirements, so designed that the spatial variation of the reverberant sound within the room is minimized, both in the steady state when the noise source is on and during decay after the source of sound has stopped.

Semi-anechoic room: A test room with a hard, reflecting floor whose other surfaces absorb essentially all the incident sound energy over the frequency range of interest, thereby affording free-field conditions above a reflecting plane.

Sound absorption: (1) the process of dissipating sound energy; (2) the property possessed by materials, objects and structures such as rooms of absorbing sound energy.

Sound attenuation: The reduction of the intensity of sound as it travels from the source to receiving location. Sound absorption is often involved as, for instance, in a lined duct. Spherical spreading and scattering are other attenuation mechanisms.

Sound power: In a specified frequency band, the rate at which sound energy is radiated by a noise source. Unit: watt (W).

Sound power level (L_w): In a specified frequency band, ten times the common logarithm of the ratio of the sound power radiated by the noise source under test to the standard reference power of 1 pW. Unit: decibel (dB).

Sound transmission loss (TL): of a partition, in a specified frequency band, ten times the common logarithm of the ratio of the airborne sound power incident on the partition to the sound power transmitted by the partition and radiated on the other side. The quantity so obtained is expressed in decibels.

Sec. 285.6 NVLAP documentation

Checklists contain definitive questions about all aspects of the NVLAP criteria for accreditation. NVLAP programs incorporate two types of checklists: (a) a General Operations Checklist and (b) a Specific Operations Checklist. In the former case, the questions are applicable to evaluating a laboratory's ability to conduct testing in general. They address factors such as the laboratory's organization, management, and quality system in addition to its testing competency. In the latter case, the checklist questions are specific to the test method(s) in the given program, and focus on the testing requirements including the assessor's observations of test demonstration(s).

(a) The NVLAP General Operations Checklist is contained in Appendix B, along with comment sheets used by the assessor in conjunction with this checklist. The questions in the General Operations Checklist follow and are numbered to correspond to the requirements in NIST Handbook 150. The comment sheets are primarily used to explain deficiencies noted on the checklist. The assessor may also use the sheets to make comments on aspects of the laboratory's performance other than deficiencies.

(b) An example of the type of Specific Operations Checklist currently used by the Acoustical Testing Services program is contained in Appendix C. Note that it is formatted as **test method review sheets**; i.e., lists of specific test methods for which the laboratory is seeking accreditation. Test method review sheets are used in conjunction with **critical elements** which are documented in the NVLAP internal handbook for use by the acoustical assessors to evaluate a laboratory's ability to conduct testing in accordance with the standard.

Sec. 285.22 Assessing and evaluating a laboratory

(a) On-Site Assessment

(1) The NVLAP assessor will request the quality manual and/or procedures in advance of the on-site assessment to reduce time spent at the laboratory. The laboratory shall be prepared for conducting test demonstrations, have all documentation available, provide access to any test reports or supporting information needed, have equipment in good working order, and be ready for examination according to the requirements identified in this handbook, NIST Handbook 150, and the laboratory's quality manual. The assessor will need time and work space to complete assessment documentation during the time at the laboratory. The assessor will need time to discuss the test methods and procedures with the laboratory personnel.

(2) An assessor performs the following activities during a typical on-site assessment:

(i) Conducts an entry briefing with the laboratory manager to explain the purpose of the on-site visit and to discuss the schedule for the day(s). At the discretion of the laboratory manager, other staff may attend the briefing.

(ii) Reviews laboratory quality manual and records, including the following:

- sample identification and tracking procedures and copies of completed test reports;

- records of periodic internal audits and use of quality control procedures and participation in interlaboratory comparisons or other similar programs; and
- personnel records, including résumés and job descriptions of key personnel and competency evaluations for all staff members who routinely perform the procedures for which accreditation is sought.

At least one laboratory staff member must be available to answer questions; however, the assessor may wish to review the documents alone. The assessor does not usually ask to take any laboratory documents out of the laboratory, and documents previously supplied will be returned.

(iii) Physically examines equipment and facilities, determines whether appropriate environmental conditions are maintained, and observes the demonstration of testing procedures by appropriate personnel assigned to conduct the tests, and discusses them with the personnel to assure their understanding of the procedures. The demonstrations must include sample test material(s), preparation of devices, establishment of test conditions and the setup/use of major equipment. The assessor may select and trace the history of one or more samples from receipt to final issuance of the test reports. Review of acoustical test room qualifications and test data.

(iv) Completes an On-Site Assessment Report, which contains the minimum requirements prescribed in NIST Handbook 150, Sec. 285.22(b)(2), as well as copies of the completed checklists.

(v) At the exit briefing, the assessor discusses the assessment findings with the laboratory personnel. Then the first page

of the report is signed by the assessor and the laboratory's Authorized Representative to acknowledge the discussion. Signing does not necessarily indicate agreement the laboratory may dispute the assessor's findings through appeals to NVLAP. All observations made by the NVLAP assessor are held in the strictest confidence. See NIST Handbook 150, Sec. 285.22 (b)(2) for further details regarding on-site assessments.

(3) NVLAP technical assessors are provided with "critical elements" in addition to the checklists described in 285.6, *NVLAP documentation,* to help assure the completeness, objectivity, and uniformity of the on-site assessment. The most frequently used methods are included in the critical elements handbook which is provided to the NVLAP assessors only. ***The critical elements handbook is a NVLAP internal document and is not for distribution.***

The critical elements include: test setup, test equipment and apparatus, test procedures, and special considerations.

(b) Proficiency Testing

Proficiency testing is generally conducted by NVLAP, using the services of a proficiency testing contractor. Proficiency testing provides for the evaluation of the laboratory's ability to produce reliable and reproducible test data and to demonstrate agreement with other interlaboratory participants' results, based upon generally accepted statistical analysis.

NVLAP-accredited laboratories are required to participate in proficiency testing when plans to conduct a proficiency test are announced. Currently NVLAP does not have a regularly scheduled proficiency testing program; however, proficiency testing rounds may be conducted as needed to evaluate laboratory proficiency. The laboratories should participate in additional interlaboratory tests outside of NVLAP as part of their quality assurance program. A sample of a recent NVLAP proficiency test on ASTM E90 is included in Appendix E. Proficiency testing may require the analysis of material samples or other test artifacts. Instructions for participating in any future NVLAP proficiency test will be provided to the laboratory.

The proficiency testing results for each laboratory will be monitored. The laboratory's accreditation may be suspended if the proficiency testing results indicate continued poor or unsatisfactory performance on consecutive proficiency testing rounds. See Sec. 285.22 (b) (4) in NIST Handbook 150 on proficiency testing.

Sec. 285.23 Granting and renewing accreditation

Laboratories granted NVLAP accreditation are provided with two documents: a Certificate of Accreditation and a Scope of Accreditation. Samples of these accreditation documents for the Acoustical Testing Services program are shown in Appendix A.

Sec. 285.33 Criteria for accreditation

(c) Quality system, audit and review

(1) A *quality system* is defined as the organizational structure, responsibilities, procedures, processes and resources for implementing quality management. Quality systems are developed by the laboratory for specific testing services by tailoring the generic guidelines for a quality system. The NVLAP requirements for a quality system are contained in the NIST Handbook 150, *NVLAP Procedures and General Requirements*.

The quality system includes the following major components: the organization and management, including a corporate quality policy; technical and quality managers, personnel training and quality audits; the facilities and equipment used in performing the specific testing functions; the calibration of test equipment, reference materials, and measurement traceability to the national standards; the laboratory operating procedures for performing the test method/process and maintaining quality control; and the records and test reports.

The laboratory must have a method for identifying items that have been received by the laboratory for testing. This identification can be used for verification of the test report and tracking the progress of the test item from the time of receipt until the test report is sent to the client.

The quality system requirements are designed to promote laboratory practices which ensure technical integrity of the analyses and adherence

to quality assurance. This information will be reviewed by NVLAP assessors during on-site assessments.

(2) Under its quality system, the laboratory shall develop and implement procedures covering all the technical requirements of this handbook. Periodic reviews of the quality system by the laboratory shall reflect adherence to NVLAP requirements and the laboratory's quality objectives. These reviews should reflect positive aspects of the quality system as well as deficiencies.

(3) The most recent editions of the quality system documents listed in Sec. 285.4 *References* should be available as references in maintaining the quality system. There should, also, be available in the laboratory general reference texts on statistics and quality assurance.

(4) The *quality manual* is generally one manual that documents and describes the quality system. It contains references to other supporting documents such as calibration records, equipment inventory and status records, operating procedures for performing the specific test, proficiency testing, quality control functions and statistical methods for controlling the quality of the laboratory function.

NVLAP requirements for the quality manual and/or supporting quality assurance procedures are listed in Sec. 285.33(c)(2) of NIST Handbook 150.

The documentation must be readily accessible to all staff members and must be in a format and style which can be easily understood by all staff members and the laboratory assessor.

(d) Personnel

(1) The laboratory shall maintain records on each staff member, including a résumé, assigned duties, laboratory procedures for which they are qualified, training, quality assurance activities, and proficiency testing information.

(2) The laboratory **technical director** shall be a person with appropriate education and experience in an acoustical testing field.

(3) The laboratory shall have a detailed documented description of its training program for new and current staff members. Each new staff member must be trained for assigned duties and existing staff members must be retrained when procedures are changed or they are assigned new responsibilities. Each staff member must receive training for assigned duties either through on-the-job training, formal classroom sessions or through certification programs.

(4) In addition to training, the competency of each staff member shall be evaluated by the laboratory either through observation of performance, oral or written examination for each test method the staff member is authorized to conduct, or other suitable means. The evaluation shall be conducted at least annually by the immediate supervisor or a designee appointed by the laboratory director. A record of the staff member's review must be placed in the personnel file, dated and signed by the supervisor and the employee.

(5) Reference documents, texts and current scientific and industry periodicals should be made available to all technical personnel to keep their knowledge up to date. An ongoing process of training and professional development is essential to the improvement of technical expertise.

(6) The laboratory shall be organized so that staff members are not subjected to undue pressure or inducement that might influence their judgment or results of their work.

(7) Employees shall be aware of the extent of their area of responsibility. This information should be available in the required job descriptions found in the quality documentation and individual files.

(f) Equipment and reference materials

(1) All facilities and equipment used for performing the applicable tests must conform with all of the requirements of the standard test methods. If by modification or design the equipment is different from that called for by the test method, the laboratory must provide satisfactory evidence (e.g., comparative test results, round-robins, analytical or mathematical proof) that use of the modified equipment

results in test data which are equivalent to what would be obtained by the test equipment specified in the test method.

(2) Laboratory acoustical test rooms must be shown to meet all requirements for the frequency range(s) of interest. Temperature and humidity must be monitored and controlled in all rooms when conducting tests. All rooms must have adequate volume to make measurements with the sound source employed. Documented data must be presented to substantiate the characterization of each room. Accreditation documents will specify the frequency range for which a test room is qualified. The microphones and all associated test equipment must be calibrated or verified, and the laboratory's calibration procedures must include written evidence of a thorough understanding of the necessary calibrations.

The laboratory workspace and any environmentally controlled spaces will be checked for proper conditions, including monitoring devices.

(3) In the case of rented equipment or leased facilities, documented evidence of an agreement for use of the facilities or equipment, and evidence of current calibrations is required by NVLAP.

(4) Special processes, such as using human subjects, shall be qualified and shall also comply with the requirements of the standard test method. This is specifically important to, but is not limited to, the field of hearing protector testing.

(g) Measurement traceability and calibration

(1) All test equipment that is inherently subject to change due to use or passage of time, must be periodically calibrated against traceable standards. All calibrations and characterizations must be done against reference standards or physical constants that are traceable to national standards maintained by NIST or by an equivalent foreign national standards authority. The reference standards used and the environmental conditions at the time of calibration must be documented for all calibrations. Calibration records and evidence of the traceability of the reference standards used must be made available for inspection during the on-site visit.

Equipment used in performing accredited test methods must be calibrated (verified) according to the following order of priority:

- as specified in the test method or in Appendix D of this handbook,
- in accordance with the manufacturer's recommendation, or
- once a year.

(2) The calibration certificate should indicate the uncertainty of the calibration, and traceability to reference standards. If the calibration is performed by the laboratory, the metrology standards used and the environmental conditions must be documented. Certificates are required for calibrations performed by outside services; they are not required for all testing equipment.

The records for each calibration and test shall contain sufficient information to permit their duplication. The records shall include the identity of personnel involved in sampling, preparation, calibration or testing.

(h) Calibration and test methods

(1) NVLAP accreditation is based on the evaluation of a laboratory's technical qualifications and competence for conducting specific standard test methods in acoustical testing. In order to maintain the quality of results of these standard tests, a laboratory must have written procedures for the laboratory personnel to follow when conducting the tests. These procedures should address any information not specifically contained in the standard method and any deviations used by the laboratory. These procedures should also include equipment operation, calibration checks, and quality control checks. The laboratory may use only the specific standard test method when determined suitable by NVLAP.

(2) The laboratory shall have readily available the latest published version of all of the test methods for which accreditation has been requested. In addition, the laboratory shall have copies of any applicable referenced standards, practices, or procedures.

(3) Specimen control records must trace the movement of specimens from sampling/receipt to completion of testing. Dates, times, condition of sample and names of personnel involved should be included.

(4) There are several field testing methods in the Acoustical Testing Services program including ASTM E336, E1007, and others. These tests may only be performed in a laboratory, or in the laboratory and the field situation, or only in the field. Hence, the accreditation might be for a combination of personnel expertise, test instruments, and knowledge of test procedures, with no physical laboratory. If a laboratory selects one of the field testing methods to be included in its scope of accreditation, the assessor will be required to review the following during the on-site assessment:

(i) a complete step-by-step procedure for personnel to follow when performing the test, including a test description and any calibrations or quality control procedures required by the test method;

(ii) a demonstration of the test procedure; and

(iii) test reports or test data sheets, and a folder or file containing the raw data for a specific test previously performed by the laboratory.

(5) A laboratory is accredited to perform tests in "strict conformance" with the standard test method as written. If a laboratory knowingly deviates from a method during the performance of a test, the deviation must be described on the final test report.

(6) ***Test method equivalence***

It has been determined that the following test method pairs are similar enough to allow accreditation for both the ISO and the ANSI standard test methods, simultaneously, under the Acoustical Testing Services program. A laboratory that is currently accredited by NVLAP for one test method may request in writing, without additional cost, that its scope of accreditation be revised to reflect the parallel standards.

(i) ISO 3741, *Sound Power Levels... Broadband Noise*, and ANSI S12.31, *Sound Power Levels... Broadband Noise*, (revision of ANSI S1.31);

(ii) ISO 3742, *Sound Power Levels... Narrow Band Noise*, and ANSI S12.32, *Sound Power Levels... Narrow Band Noise*, (revision of ANSI S1.32);

(iii) ISO 7779, *Airborne Noise by Computer and Business Equipment,* and ANSI S12.10, *Noise Emitted by Computer and Business Equipment*.

(j) Records

(1) Test reports should be retained for 3 years following the completion of testing, unless a longer period is required by the client, regulation, or the laboratory's own procedures. Supporting test records and data should also be retained in order to verify or reconstruct the test report if necessary. It is recommended that test reports older than 3 years be maintained on microfilm, microfiche, or computer data disks.

(2) Records covering the following items are required and will be reviewed during the on-site visit either in total or by selected sampling:

(i) staff training dates and results;

(ii) staff competency review dates and results;

(iii) equipment calibration and maintenance;

(iv) test data and reports;

(v) specimen control;

(vi) records of internal audits; and

(vii) interlaboratory testing or comparisons.

APPENDIX A

SAMPLE ACCREDITATION DOCUMENTS

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ISO/IEC GUIDE 25:1990
ISO/IEC GUIDE 58:1993
ISO 9002:1994

Certificate of Accreditation

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

LABORATORY NAME
ANYTOWN, USA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

ACOUSTICAL TESTING SERVICES

January 1, 19--
Effective until

For the National Institute of Standards and Technology

NVLAP LAB CODE: 0000

National Institute of Standards and Technology **NVLAP®** *National Voluntary Laboratory Accreditation Program*

ISO/IEC GUIDE 25:1990
ISO/IEC GUIDE 58:1993
ISO 9002:1994

Scope of Accreditation

ACOUSTICAL TESTING SERVICES **NVLAP LAB CODE 0000**

LABORATORY NAME
ANYTOWN, USA 00000-0000
John Doe Phone: 000-000-0000

NVLAP Code	*Designation*	*Short Title*
08/P03	ASTM C423	Sound Absorption and Sound Absorption Coefficients
08/P06	ASTM E90	Airborne Sound Transmission Loss of Building Partitions
08/P08	ASTM E596	Noise Reduction of Sound-Isolating Enclosures
08/P10	ANSI S12.31	Sound Power Levels, Broadband Noise Sources in Reverberation Rooms
08/P17	ISO 3741	Sound Power Levels - Broadband Sources
08/P25	ANSI S12.10	Noise emitted by computer business and equipment
08/P24	ISO 7779	Airborne noise by computer and business equipment

January 1, 19--
Effective until

For the National Institute of Standards and Technology

APPENDIX B

GENERAL OPERATIONS CHECKLIST

GENERAL OPERATIONS CHECKLIST

Instructions to the Assessor: This checklist addresses general accreditation criteria prescribed in applicable sections of NIST Handbook 150, *NVLAP Procedures and General Requirements*.

This checklist follows and is numbered to correspond to the *NVLAP Procedures and General Requirements*, Subsection 285.33. The numbers in square brackets identify related checklist items. A small black triangle appears in the left-hand margin of selected lines of text throughout this checklist; the marked text applies only to the Calibration Laboratory Accreditation Program (LAP).

Place an "X" beside each checklist item which represents a deficiency. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and your written deficiency explanations and/or comments in this list or on the attached comment sheets. Place a check beside all other items you observed or verified at the laboratory.

SEC. 285.33 CRITERIA FOR ACCREDITATION

(b) ***Organization and management***

(1) The laboratory shall be:

_____ (i) legally identifiable;

Legal name of laboratory ownership: _____

(ii) organized and shall operate in such a way that its permanent, temporary and mobile facilities meet the NVLAP requirements [see also (b)(2)(i), (c)(2)(ii)];

_____ (iii) properly identified on the NVLAP Application.

(2) The laboratory shall:

_____ (i) have managerial staff with the authority and resources needed to discharge their duties [see also (b)(1)(ii), (c)(2)(ii)];

_____ (ii) have policies to ensure that its personnel are free from any commercial, financial and other pressures which might adversely affect the quality of their work;

_____ (iii) be organized in such a way that confidence in its independence of judgment and integrity is maintained at all times;

_____ (iv) specify and document the responsibility, authority and interrelation of all personnel who manage, perform or verify work affecting the quality of calibrations and tests;

_____ (v) provide supervision by persons familiar with the calibration or test methods and procedures, the objective of the calibration or test, and the assessment of the results. The ratio of supervisory to non-supervisory personnel shall be such as to ensure adequate supervision;

_____ (vi) have a technical manager (however named) who has overall responsibility for the technical operations;

Name of person: _____

_____ (vii) have a quality manager (however named) who has responsibility for the quality system and its implementation. The quality manager shall have direct access to the highest level of management at which decisions are taken on laboratory policy or resources, and to the technical manager. In some laboratories, the quality manager may also be the technical manager or deputy technical manager;

Name of person: _____

_____ (viii) nominate deputy(ies) in case of absence of the technical or quality manager;

Name(s): _____

_____ (ix) have documented policy and procedures to ensure the protection of clients' confidential information and proprietary rights [see also (c)(2)(xviii)];

_____ (x) where appropriate, participate in interlaboratory comparisons and proficiency testing programs [see also (c)(2)(xiv), (c)(6)(ii), (g)(3)];

_____ (xi) have documented policy and procedures to ensure that its clients are served with impartiality and integrity.

(c) ***Quality system, audit and review***

(1) The laboratory shall:

_____ (i) have an established and maintained quality system appropriate to the type, range and volume of calibration and testing activities it undertakes;

_____ (ii) have the elements of the quality system documented;

_____ (iii) ensure that the quality documentation is available for use by the laboratory personnel;

_____ (iv) define and document its policies and objectives for, and its commitment to, good laboratory practice and quality of calibration or testing services;

_____ (v) have the laboratory management which ensures that these policies and objectives are documented in a quality manual and communicated to, understood, and implemented by all laboratory personnel concerned;

_____ (vi) ensure that the quality manual is maintained current under the responsibility of the quality manager [see also (c)(2)(iv)].

Date of quality manual: _____

Date of latest update: _____

(2) The quality manual, and related quality documentation, shall state the laboratory's policies and operational procedures established in order to meet the NVLAP requirements. The quality manual and related quality documentation shall contain:

_____ (i) a quality policy statement, including objectives and commitments, by top management;

_____ (ii) the organization and management structure of the laboratory, its place in any parent organization and relevant organizational charts;

_____ (iii) the relations between management, technical operations, support services and the quality system;

_____ (iv) procedures for control and maintenance of documentation [see also (c)(1)(vi), (j)(1)];

_____ (v) job descriptions of key staff and reference to the job descriptions of other staff;

_____ (vi) identification of the laboratory's approved signatories (list here or in the comments section): _____

_____

_____ (vii) the laboratory's procedures for achieving traceability of measurements;

_____ (viii) the laboratory's scope of calibrations and/or tests;

_____ (ix) written procedures for ensuring that the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work;

_____ (x) reference to the calibration, verification and/or test procedures used;

_____ (xi) procedures for handling calibration and test items;

_____ (xii) reference to the major equipment and reference measurement standards used;

_____ (xiii) reference to procedures for calibration, verification and maintenance of equipment;

_____ (xiv) reference to verification practices including interlaboratory comparisons, proficiency testing programs, use of reference materials and internal quality control schemes [see also (b)(2)(x), (c)(6)(ii), (g)(3)];

(xv) procedures to be followed for feedback and corrective action whenever:

_____ a) testing discrepancies are detected, or

_____ b) departures from documented policies and procedures occur;

_____ (xvi) the laboratory management policies for departures from documented policies and procedures or from standard specifications;

_____ (xvii) procedures for dealing with complaints [see also (n)];

_____ (xviii) procedures for protecting confidentiality and proprietary rights [see also (b)(2)(ix)];

_____ (xix) procedures for audit and review;

_____ (xx) a description of the laboratory's policy regarding the use of the NVLAP logo;

▸ _____ (xxi) a statement of the laboratory's policy for establishing and changing
▸ calibration intervals for equipment it controls; and

▸ _____ (xxii) a statement of the laboratory's policy concerning the technique(s) to be used
▸ for determining measurement uncertainty and calibration/verification
▸ adequacy.

_____ (3) The laboratory shall arrange for audits of its activities at appropriate intervals to verify that its operations continue to comply with the requirements of the quality system. Such audits shall be carried out by trained and qualified staff who are, wherever possible, independent of the activity to be audited. Where the audit findings cast doubt on the correctness or validity of the laboratory's calibration or test results, the laboratory shall take immediate corrective action and shall immediately notify, in writing, any client whose work may have been affected.

The audits shall be objective and be conducted internally or on contract. The audits shall include both general criteria (documents, records and policies) and technical compliance (test methods and practices and calibration procedures).

_____ (4) The quality system adopted to satisfy the NVLAP requirements shall be reviewed at least once a year by the management to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements.

_____ (5) All audit and review findings and any corrective actions that arise from them shall be documented. The person responsible for quality shall ensure that these actions are discharged within the agreed timescale.

(6) In addition to periodic audits the laboratory shall ensure the quality of results provided to clients by implementing checks. These checks shall be reviewed and shall include, as appropriate, but not be limited to:

_____ (i) internal quality control plans, such as control charts and other available statistical techniques;

NOTE: Measurement assurance techniques are acceptable means to control the measurement process and consistently produce the highest quality measurements.

_____ (ii) participation in proficiency testing or other interlaboratory comparisons [see also (b)(2)(x), (c)(2)(xiv), (g)(3)];

_____ (iii) regular use of certified reference materials and/or in-house quality control using secondary reference materials;

_____ (iv) replicate testings using the same or different methods;

_____ (v) retesting of retained items;

_____ (vi) correlation of results for different characteristics of an item.

(d) ***Personnel*** [see also (c)(2)(v)]

_____ (1) The testing laboratory shall have sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions.

_____ (2) The testing laboratory shall ensure that the training of its personnel is kept up-to-date.

_____ (3) Records on the relevant qualifications, training, skills and experience of the technical personnel shall be maintained by the laboratory.

(e) ***Accommodation (facilities) and environment*** [see also (i)(3)]

_____ (1) Laboratory accommodation, calibration and test areas, energy sources, lighting, heating and ventilation shall be such as to facilitate proper performance of calibrations or tests.

NOTE: Laboratory design will be, to the maximum extent practical, in accordance with the guidelines found in the NCSL Recommended Practice #7, *Laboratory Design*, July 25, 1993.

_____ (2) The environment in which these activities are undertaken shall not invalidate the results or adversely affect the required accuracy of measurement. Particular care shall be taken when such activities are undertaken at sites other than the permanent laboratory premises.

NOTE: It is expected that environments which do not meet generally accepted norms, such as those found in NCSL Recommended Practice #7, yet which exhibit the stability required to apply necessary correction factors, will be specified by the laboratory for the purpose of assessment of compliance with its own procedures to achieve its stated uncertainties.

_____ (3) The laboratory shall provide facilities for the effective monitoring, control and recording of environmental conditions as appropriate. Due attention shall be paid, for example, to biological sterility, dust, electromagnetic interference, humidity, voltage, temperature, and sound and vibration levels, as appropriate to the calibrations or tests concerned.

_____ (4) There shall be effective separation between neighboring areas when the activities therein are incompatible.

_____ (5) Access to and use of all areas affecting the quality of these activities shall be defined and controlled.

_____ (6) Adequate measures shall be taken to ensure good housekeeping in the laboratory.

NOTE: While it is the laboratory's responsibility to comply with relevant health and safety requirements, this is outside the scope of this assessment.

(f) ***Equipment and reference materials***

(1) The laboratory shall:

_____ (i) be furnished with all items of equipment (including hardware, software, and reference materials) required for the correct performance of calibrations and tests;

_____ (ii) in those cases where the laboratory needs to use equipment outside its permanent control, including rented, leased and client-owned equipment, ensure that the relevant NVLAP requirements are met.

_____ (2) All equipment shall be properly maintained. Maintenance procedures shall be documented. Any item of the equipment which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown by verification or otherwise to be defective, shall be taken out of service, clearly identified and wherever possible stored at a specified place until it has been repaired and shown by calibration, verification or test to perform satisfactorily. The laboratory shall examine the effect of this defect on previous calibrations or tests.

_____ (3) Each item of equipment including reference materials shall, when appropriate, be labelled, marked or otherwise identified to indicate its calibration status.

_____ (4) Records shall be maintained of each item of equipment and all reference materials significant to the calibrations or tests performed. The records shall include:

_____ (i) the name of the item of equipment, software or reference material;

_____ (ii) the manufacturer's name, type identification, and serial number or other unique identification;

_____ (iii) date received and date placed in service;

NOTE: For initial accreditation, the date received and the date placed in service are not considered mandatory requirements for inclusion in laboratory records, although this is encouraged as good laboratory practice.

_____ (iv) current location, where appropriate;

_____ (v) condition when received (e.g., new, used, reconditioned);

_____ (vi) copy of the manufacturer's instructions, where available;

_____ (vii) dates and results of calibrations and/or verifications and date of next calibration and/or verification;

_____ (viii) details of maintenance carried out to date and planned for the future;

_____ (ix) history of any damage, malfunction, modification or repair;

▸ _____ (x) measured value observed for each parameter found to be out of tolerance
▸ during calibration/verification.

(g) ***Measurement traceability and calibration***

_____ (1) All measuring and testing equipment having an effect on the accuracy or validity of calibrations or tests shall be calibrated and/or verified before being put into service. The laboratory shall have an established program for the calibration and verification of its measuring and test equipment. The program will ensure the recall or removal from service of any standard or equipment which has exceeded its calibration interval or is otherwise judged to be unreliable.

_____ (2) The overall program of calibration and/or verification and validation of equipment shall be designed and operated so as to ensure that, wherever applicable, measurements made by the laboratory are traceable to national standards of measurement where available. Calibration certificates shall, wherever applicable, indicate the traceability to national standards of measurement and shall provide the measurement results and associated uncertainty of measurement and/or a statement of compliance with an identified metrological specification.

NOTE: Traceability to national standards includes traceability to standards maintained or defined at national laboratories in foreign countries where applicable. In these cases, traceability is achieved via international standards. This includes intrinsic standards of measurement where available.

Where applicable, the methodology of the *Guide to the expression of uncertainty in measurement*: 1993, shall be used as the basis for expression of uncertainty of the measurement. NIST Technical Note 1297; January 1993, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, is a practical application document written around the *Guide to the expression of uncertainty in measurement*. Where detailed procedures are not used to quantify and combine uncertainties (i.e., use of test accuracy ratio concepts), the sources of uncertainty shall be tabulated and demonstrated to be acceptable for the measurement undertaken.

NOTE: A significant number of intrinsic standards, such as the Josephson Array Voltage Standard and the Iodine-Stabilized Helium-Neon Laser Length Standard, have been developed and are now being used by many national standards laboratories and some industrial laboratories. These standards are based on well-characterized laws of physics, fundamental constants of nature, or invariant properties of materials, and make ideal stable, precise, and accurate measurement standards if properly designed, characterized, operated, monitored and maintained. Where intrinsic standards are used, the laboratory should demonstrate by measurement assurance techniques, interlaboratory comparisons, or other suitable means, that its intrinsic standard measurement results are correlated with those of national or international standards.

_____ (3) Where traceability to national standards of measurement is not applicable, the laboratory shall provide satisfactory evidence of correlation of results, for example by participation in a suitable program of interlaboratory comparisons or proficiency testing [see also (b)(2)(x), (c)(2)(xiv), (c)(6)(ii)].

NOTE: Traceability requirements may also be satisfied by:

(i) internationally accepted standards in the field concerned;

(ii) suitable reference materials;

(iii) ratio or reciprocity measurements; or

(iv) mutual consent standards which are clearly specified and mutually agreed upon by all parties concerned.

_____ (4) Reference standards of measurement held by the laboratory shall be used for calibration only and for no other purpose, unless it can be demonstrated that their performance as reference standards has not been invalidated.

_____ (5) Reference standards of measurement shall be calibrated by a body that can provide traceability to a national standard of measurement. There shall be a program of calibration and verification for reference standards.

_____ (6) Where relevant, reference standards and measuring and testing equipment shall be subjected to in-service checks between calibrations and verifications.

_____ (7) Reference materials shall, where possible, be traceable to national or international standards of measurement, or to national or international standard reference materials.

(h) ***Calibration and test methods***

_____ (1) The laboratory shall have documented instructions on the use and operation of all relevant equipment, on the handling and preparation of items and for calibration and/or testing, where the absence of such instructions could jeopardize the calibrations or tests. All instructions, standards, manuals and reference data relevant to the work of the laboratory shall be maintained up-to-date and be readily available to the staff.

_____ (2) The laboratory shall use appropriate methods and procedures for all calibrations and tests and related activities within its responsibility (including sampling, handling, transport and storage, preparation of items, estimation of uncertainty of measurement and analysis of calibration and/or test data). They shall be consistent with the accuracy required, and with any standard specifications relevant to the calibrations or tests concerned.

NOTES:

(i) Calibration procedures shall contain the required range and tolerance or uncertainty of each item or unit parameter being calibrated or verified. In addition, the procedures shall contain the generic description of the measurement standards and equipment needed with the required parameter, range, tolerances or uncertainties, and specifications for performing the measurement of the calibration or verification, and/or representative types (manufacturer, model, option) that are capable of meeting the generic description for the measurement standards. The procedures shall be consistent with the accuracy required, and with any standard specifications relevant to the calibrations/verifications concerned.

(ii) The laboratory shall ensure that the calibration uncertainties are sufficiently small so that the adequacy of the measurement is not affected. Well-defined and documented measurement assurance techniques or uncertainty analyses may be used to verify the adequacy of a measurement process. If such techniques are not used, then the collective uncertainty of the measurement standards shall not exceed 25% of the acceptable tolerance (e.g., manufacturer's specification) for each characteristic of the measuring and test equipment being calibrated or verified.

_____ (3) Where methods are not specified, the laboratory shall, wherever possible, select methods that have been published in international or national standards, those published by reputable technical organizations or in relevant scientific texts or journals.

_____ (4) Where it is necessary to employ methods that have not been established as standard, these shall be subject to agreement with the client, be fully documented and validated, and be available to the client and other recipients of the relevant reports [see also (k)(2)(x)].

_____ (5) Where sampling is carried out as part of the test method, the laboratory shall use documented procedures and appropriate statistical techniques to select samples [see also (k)(2)(ix)].

_____ (6) Calculations and data transfers shall be subject to appropriate checks.

(7) Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of calibration or test data, the laboratory shall have written procedures which ensure that:

_____ (i) the NVLAP requirements are complied with;

_____ (ii) computer software, computers or automated equipment is documented and adequate for use;

_____ (iii) procedures are established and implemented for protecting the integrity of data; such procedures shall include, but not be limited to, integrity of data entry or capture, data storage, data transmission and data processing;

_____ (iv) computer and automated equipment is maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data [see also (f)(1)];

_____ (v) it establishes and implements appropriate procedures for the maintenance of security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records.

_____ (8) Documented procedures shall exist for the purchase, reception and storage of consumable materials used for the technical operations of the laboratory [see also (m)(2)].

(i) ***Handling of calibration and test items***

_____ (1) The laboratory shall have a documented system for uniquely identifying the items to be calibrated or tested, to ensure that there can be no confusion regarding the identity of such items at any time [see also (k)(2)(v)].

_____ (2) Upon receipt, the condition of the calibration or test item, including any abnormalities or departures from standard condition as prescribed in the relevant calibration or test method, shall be recorded. Where there is any doubt as to the item's suitability for calibration or test, where the item does not conform to the description provided, or where the calibration or test required is not fully specified, the laboratory shall consult the client for further instruction before proceeding. The laboratory shall establish whether the item has received all necessary preparation, or whether the client requires preparation to be undertaken or arranged by the laboratory.

_____ (3) The laboratory shall have documented procedures and appropriate facilities to avoid deterioration or damage to the calibration or test item, during storage, handling, preparation, and calibration or test; any relevant instructions provided with the item shall be followed. Where items have to be stored or conditioned under specific environmental conditions, these conditions shall be maintained, monitored and recorded where necessary. Where a calibration or test item or portion of an item is to be held secure (for example, for reasons of record, safety or value, or to enable check calibrations or tests to be performed later), the laboratory shall have storage and security arrangements that protect the condition and integrity of the secured items or portions concerned [see also (e)].

_____ (4) The laboratory shall have documented procedures for the receipt, retention or safe disposal of calibration or test items, including all provisions necessary to protect the integrity of the laboratory.

_____ (5) Tamper-resistant seals shall be affixed to operator-accessible controls or adjustments on measurement standards or measuring and test equipment which, if moved, will invalidate the calibration. The laboratory's calibration system shall provide instructions for the use of such seals and for the disposition of equipment with damaged or broken seals.

NOTE: Tamper-resistant seals are sometimes affixed to equipment to prevent unauthorized access to areas where adjustments or critical components are located.

(j) ***Records***

_____ (1) The laboratory shall maintain a record system to suit its particular circumstances and comply with any applicable regulations. It shall retain on record all original observations, calculations and derived data, calibration records and a copy of the calibration certificate, test certificate or test report for an appropriate period. The records for each calibration and test shall contain sufficient information to permit their repetition. The records shall include the identity of personnel involved in sampling, preparation, calibration or testing [see also (c)(2)(iv)].

▸ **EXCEPTION:** The retention of all original observations, calculations, and
▸ derived data in the calibration record system is not a mandatory requirement
▸ for calibration laboratories, although it is encouraged as good laboratory
▸ practice.

_____ (2) All records (including those listed in (f)(4) pertaining to calibration and test equipment), certificates and reports shall be safely stored, held secure and in confidence to the client [see also (b)(2)(ix), (c)(2)(xviii)].

NOTE: The period of retention shall be specified in the quality manual.

Record retention time specified: _____

(k) ***Certificates and reports***

_____ (1) The results of each calibration, test, or series of calibrations or tests carried out by the laboratory shall be reported accurately, clearly, unambiguously and objectively, in accordance with any instructions in the calibration or test methods. The results should normally be reported in a calibration certificate, test report or test certificate and should include all the information necessary for the interpretation of the calibration or test results and all information required by the method used [see also (k)(4)(i)].

▸ **NOTE:** It is recognized that the results of each calibration do not always
▸ result in the production of a calibration certificate or report. Whenever a
▸ certificate or report is produced, the above requirements shall be met.

(2) Each certificate or report shall include at least the following information:

_____ (i) a title, e.g., "Calibration Certificate," "Test Report" or "Test Certificate";

_____ (ii) name and address of laboratory, and location where the calibration or test was carried out if different from the address of the laboratory;

_____ (iii) unique identification of the certificate or report (such as serial number) and of each page, and the total number of pages;

_____ (iv) name and address of client, where appropriate;

_____ (v) description and unambiguous identification of the item calibrated or tested [see also (i)(1)];

_____ (vi) characterization and condition of the calibration or test item;

_____ (vii) date of receipt of calibration or test item and date(s) of performance of calibration or test, where appropriate;

▸ **EXCEPTION:** Although it is encouraged as good laboratory practice, the
▸ requirement for inclusion of the date received is not mandatory for
▸ calibration laboratories.

_____ (viii) identification of the calibration or test method used, or unambiguous description of any non-standard method used;

_____ (ix) reference to sampling procedure, where relevant [see also (h)(5)];

_____ (x) any deviations from, additions to or exclusions from the calibration or test method, and any other information relevant to a specific calibration or test, such as environmental conditions [see also (c)(2)(xv), (h)(4)];

_____ (xi) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified;

_____ (xii) a statement of the estimated uncertainty of the calibration or test result, where relevant;

_____ (xiii) a signature and title, or an equivalent identification of the person(s) accepting responsibility for the content of the certificate or report (however produced), and date of issue [see also (c)(2)(vi)];

_____ (xiv) where relevant, a statement to the effect that the results relate only to the items calibrated or tested;

_____ (xv) a statement that the certificate or report shall not be reproduced except in full, without the written approval of the laboratory;

_____ (xvi) a statement that the report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government;

_____ (xvii) the signature of an approved signatory for all test and calibration reports endorsed with the NVLAP logo;

▸ _____ (xviii) special limitations of use; and

▸ _____ (xix) traceability statement.

_____ (3) Where the certificate or report contains results of calibrations or tests performed by subcontractors, these results shall be clearly identified [see also (l)].

_____ (4) Particular care and attention shall be paid to the arrangement of the certificate or report, especially with regard to presentation of the calibration or test data and ease of assimilation by the reader. The format shall be carefully and specifically designed for each type of calibration or test carried out, but the headings shall be standardized as far as possible [see also (k)(1)].

_____ (5) Material amendments to a calibration certificate, test report or test certificate after issue shall be made only in the form of a further document, or data transfer including the statement "Supplement to Calibration Certificate (or Test Report or Test Certificate), serial number ... (or as otherwise identified)," or equivalent form of wording. Such amendments shall meet all the relevant requirements of item (j).

_____ (6) The laboratory shall notify clients promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any calibration certificate, test report, or test certificate or amendment to a report or certificate.

▸ **NOTE:** Such notification shall quantify the magnitude of error created in the
▸ calibration results. The laboratory shall notify customers promptly, in
▸ writing, of any customer's measuring and test equipment found significantly
▸ out of tolerance during the calibration/verification process. Measurement
▸ data shall be reported so that appropriate action can be taken.

_____ (7) The laboratory shall ensure that, where clients require transmission of calibration or test results by telephone, telex, facsimile or other electronic or electromagnetic means, staff will follow documented procedures that ensure that the NVLAP requirements are met and that confidentiality is preserved.

_____ (8) Whenever a laboratory accredited by NVLAP issues a calibration or test report which contains data covered by the accreditation and also data not covered by the accreditation, it must clearly identify in its records, and in the report to the client, specifically which calibration or test method(s), or portion of a calibration or test method(s), was not covered by the accreditation. The laboratory must also inform the client, before the fact, when calibrations or tests requested are not covered by the accreditation.

NVLAP policy regarding calibration and test reports issued by an accredited laboratory, which reference the laboratory's accredited status, requires that any calibration or test report containing data from calibrations or tests which are not covered by the accreditation include:

_____ (i) a statement at the beginning of the report prominently indicating, "This report contains data which are not covered by the NVLAP accreditation"; and

_____ (ii) a clear indication of which data are not covered by the accreditation.

The laboratory must not misrepresent its accreditation. When a client requires or requests accredited services and any of the requested services are not covered by the accreditation, the client must be so advised.

(l) ***Subcontracting of calibration or testing*** [see also (k)(3)]

_____ (1) Where a laboratory subcontracts any part of the calibration or testing, this work shall be placed with a laboratory complying with these requirements. The laboratory shall ensure and be able to demonstrate that its subcontractor is competent to perform the activities in question and complies with the same criteria of competence as the laboratory in respect of the work being subcontracted. The laboratory shall advise the client in writing of its intention to subcontract any portion of the testing to another party.

_____ (2) The laboratory shall record and retain details of its investigation of the competence and compliance of its subcontractors and maintain a register of all subcontracting.

_____ (3) A NVLAP-accredited laboratory intending to subcontract testing or calibration work that will be performed and reported as meeting NVLAP procedures and criteria must:

_____ (i) have in its quality manual a subcontracting policy compatible with the NVLAP policy, with a description of the procedures for administering and implementing those actions to demonstrate the conformance and consistency of the subcontracted laboratory to perform according to NVLAP procedures;

_____ (ii) place the subcontracted work with a laboratory that maintains accreditation established by NVLAP shown by a current NVLAP Lab Code, or provide and maintain current records that demonstrate that the subcontracted laboratory is competent to perform the test(s) or calibration(s) and that it operates in a manner consistent with and in conformance to NVLAP criteria for accreditation;

_____ (iii) clearly identify in its records, and in the report to the client, exactly which data were obtained by the NVLAP-accredited laboratory and which data were obtained by the subcontractor, NVLAP-accredited or not;

_____ (iv) inform its client, before the fact, that it intends to subcontract for completion of all or a portion of the client's work; and

_____ (v) include at the beginning of the report the name, address, and contact person of the subcontracted laboratory(ies), and one of the following statements, as appropriate:

if NVLAP-accredited

"This report contains data which were produced by a subcontracted laboratory **ACCREDITED (NVLAP LAB CODE)** for the calibration or test methods performed"

if not NVLAP-accredited

"This report contains data which were produced by a subcontracted laboratory **NOT ACCREDITED** for the calibration or test methods performed."

The requirements of this section do not supersede any regulation, law, contract specification, or other related conditions which require NVLAP accreditation.

(m) ***Outside support services and supplies***

_____ (1) Where the laboratory procures outside services and supplies in support of calibrations or tests, the laboratory shall use only those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's calibrations or tests.

_____ (2) Where no independent assurance of the quality of outside support services or supplies is available, the laboratory shall have procedures to ensure that purchased equipment, materials and services comply with specified requirements. The laboratory should, wherever possible, ensure that purchased equipment and consumable materials are not used until they have been inspected, calibrated or otherwise verified as complying with any standard specifications relevant to the calibrations or tests concerned [see also (h)(8)].

_____ (3) The laboratory shall maintain records of all suppliers from whom it obtains support services or supplies required for calibrations or tests.

(n) ***Complaints*** [see also (c)(2)(xvii)]

_____ (1) The laboratory shall have documented policy and procedures for the resolution of complaints received from clients or other parties about the laboratory's activities. A record shall be maintained of all complaints and of the actions taken by the laboratory.

_____ (2) Where a complaint, or any other circumstance, raises doubt concerning the laboratory's compliance with the laboratory's policies or procedures, or with the NVLAP requirements or otherwise concerning the quality of the laboratory's calibrations or tests, the laboratory shall ensure that those areas of activity and responsibility involved are promptly audited in accordance with item (c)(3).

(o) ***Measuring and test equipment (M & TE)***

NOTE: This section applies to the control of measuring and test equipment (M & TE) used to assure that supplies and services comply with prescribed customer requirements. It is based in large part on the requirements found in government audit standards such as MIL-STD 45662A, and is found in Part II of the ANSI/NCSL Z540-1-1994 (Draft) standard.

(1) General requirements for M & TE

_____ (i) The supplier shall establish and document a system to control the calibration/verification of M & TE.

_____ (ii) M & TE used to determine compliance with customer technical specifications shall be calibrated or verified in accordance with sections 285.33(b) through (n).

_____ (iii) The supplier shall have a program to recall for calibration or verification, or remove from service, M & TE that has exceeded its calibration interval, has broken calibration seals, or is suspected to be malfunctioning because of mishandling, misuse, or unusual results.

_____ (iv) All operations performed by the supplier in compliance with these requirements shall be subject to customer verification at unscheduled intervals.

_____ (v) The supplier shall carry out, or arrange to have carried out, periodic quality auditing of the calibration and verification system in order to ensure its continuing effective implementation and compliance with these requirements.

- Based on the results of the audits and any other relevant factors, such as customer feedback, the supplier shall review and modify the system as necessary.

- Plans and procedures for the audits shall be documented. The conduct of the audit and any subsequent corrective action shall also be documented.

(2) Detailed requirements for M & TE

_____ (i) Calibration system description: The supplier shall provide and maintain a written description of the calibration/verification system covering M & TE and measurement standards. The description shall be sufficient to satisfy each requirement of section 285.33(o) and any deviations shall be submitted with supporting documentation to the customer for approval.

_____ (ii) Adequacy of measurement standards: Measurement standards used by the supplier for calibrating M & TE and other measurement standards shall comply with the requirements of items (f)(1), (g)(1), and (h)(2).

_____ (iii) Environmental conditions: M & TE shall be used in an environment controlled to the extent necessary to ensure valid results. Due consideration shall be given to temperature, humidity, lighting, vibration, dust control, cleanliness, electromagnetic interference and any other factors affecting the results of measurements. Where pertinent, these factors shall be monitored and recorded and, when appropriate, correcting compensations shall be applied to measurement results.

_____ (iv) Intervals of calibration and verification: M & TE requiring calibration shall be calibrated or verified at periodic intervals established and maintained to assure acceptable reliability, where reliability is defined as the probability that M & TE will remain in-tolerance throughout the interval. Intervals shall be established for all M & TE requiring calibration unless the equipment is regularly monitored through the use of check standards in a documented measurement assurance process. Check standards must closely represent the item parameters normally tested in the process and the check standard must be verified periodically. Where intervals are used to ensure reliability, the interval setting system must be systematically applied and shall have stated reliability goals and a method of verifying that the goals are being attained. Intervals may be based on usage or time since last calibration or verification. All exemptions from periodic calibration or verification shall be documented. The recall system may provide for the temporary extension of the calibration due date for limited periods of time under specified conditions that do not unreasonably impair the satisfaction of the customer's requirements.

_____ (v) Calibration procedures: Procedures used to calibrate/verify the supplier's M & TE shall comply with the requirements of items (h)(1) and (h)(2).

_____ (vi) Out-of-tolerance conditions: If any M & TE is found to be significantly out of tolerance during the calibration/verification process, the supplier's system shall provide for notification to the user and to the supplier's quality element, if appropriate, of the out-of-tolerance condition with the associated measurement data so that appropriate action can be taken.

_____ (vii) Adequacy of calibration system: The supplier shall establish and maintain documented procedures to evaluate the adequacy of the calibration system and to ensure compliance with these requirements.

_____ (viii) Calibration sources: M & TE requiring calibration shall be calibrated or verified by laboratories that comply with sections 285.33(b) through (n).

_____ (ix) Records: These requirements shall be supported by records documenting that established schedules and procedures are followed to maintain the adequacy of all M & TE. The records for M & TE requiring calibration shall include an individual record of calibration or verification, or other means of control, providing a description or identification of the item, calibration interval, date calibrated, identification of the calibration source, calibration results (data and/or condition status) and calibration action taken (adjusted, repaired, new value assigned, derated, etc.).

_____ (x) Calibration status: M & TE shall be labeled to indicate calibration or verification status. The label shall identify specific date calibrated (day, month, year, Julian date, or equivalent) and the specific calibration due date or usage equivalent. Items not calibrated to their full capability or which have other limitations of use, shall be labeled or otherwise identified as to the limitations. When it is impractical to apply a label directly to an item, the label may be affixed to the instrument container or some other suitable means may be used to reflect calibration status. Tamper-resistant seals are affixed to operator accessible controls or adjustments which if moved will invalidate the calibration. The quality system shall provide instructions for the disposition of equipment with broken tamper-resistant seals.

_____ (xi) Control of subcontractor calibration: The supplier is responsible for assuring that the subcontractor's calibration system conforms to section 285.33 (l) to the degree necessary to assure compliance with contractual requirements. NVLAP accreditation of the subcontractor's laboratory can serve as the basis for compliance with this requirement.

_____ (xii) Storage and handling: M & TE shall be handled, stored, and transported in a manner which shall not adversely affect the calibration or condition of the equipment.

NVLAP LAB CODE:

GENERAL OPERATIONS CHECKLIST - COMMENTS AND DEFICIENCIES

Instructions to the Assessor: Use this sheet to document comments and deficiencies. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and deficiencies with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

Item No.	*Comments and/or Deficiencies*

NVLAP LAB CODE: _____

GENERAL OPERATIONS CHECKLIST - COMMENTS AND DEFICIENCIES

Instructions to the Assessor: Use this sheet to document comments and deficiencies. For each, identify the appropriate item number from the checklist. Identify comments with a "C" and deficiencies with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

Item No.	*Comments and/or Deficiencies*

APPENDIX C

SPECIFIC OPERATIONS CHECKLIST

This program uses **test method review sheets** in conjunction with critical elements to evaluate a laboratory's ability to conduct construction materials testing. Test method review sheets list the specific test methods for which the laboratory is seeking accreditation.

An example is included in this appendix.

NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM

ON-SITE ASSESSMENT - TEST METHOD REVIEW

Instructions to the Assessor:

During the on-site visit you will be required to assess the laboratory's ability to conduct the specific test methods for which it has applied for accreditation. In some cases this will involve many test methods. You may not have sufficient time to perform an in-depth assessment of each method.

Use the attached sheets to indicate which test methods you assessed at the laboratory, and the extent of your assessment. Indicate whether you performed an in-depth review, including a full review of laboratory activities. These include sample control and preparation, procedure review, observation of actual testing, environmental control check, equipment review, calibration checks, record-keeping practices and report forms; or, that you observed selected items to determine that the laboratory demonstrated the ability to conduct the test.

The specific requirements for each test method are detailed in the CRITICAL ELEMENTS, the HANDBOOK, and/or the TEST METHOD. Any items required under "special considerations" will be described either in the CRITICAL ELEMENTS, special instructions below, or in other correspondence.

Fill out the ON-SITE ASSESSMENT - TEST METHOD REVIEW SUMMARY by writing in the test method designation. Indicate on the summary the DEPTH of the assessment for each test method you reviewed, using one of the symbols shown below:

OT - (Observed Test)
EA - (Examined Apparatus)
W/TT - (Walked/Talked Through)
LDP - (Listened to Description of Procedures)

All ***deficiencies*** must be accompanied by a comment.

Use the ON-SITE ASSESSMENT - TEST METHOD REVIEW COMMENTS AND DEFICIENCIES sheets to write comments on what you observed. Preface each comment with the test method designation to which the comment applies. Please be liberal with your comments so that we have a good written record of your observations; the more information we have, the better the accreditation decision we can make.

Special Instruction:

NVLAP LAB CODE:

National Voluntary Laboratory Accreditation Program (NVLAP)

ON-SITE ASSESSMENT - TEST METHOD REVIEW SUMMARY

Test Method (number, name or designation)	Depth of Assessment	Environmental/ Test Sample Conditioning	Test Equipment and Apparatus	Calibration	Test Procedures	Test Reports	Special Considerations

NVLAP LAB CODE: _____

ON-SITE ASSESSMENT - TEST METHOD REVIEW COMMENTS AND DEFICIENCIES

Instructions to the Assessor: Use this sheet to document comments and deficiencies. For each, identify the appropriate item number. Identify comments with a "C" and deficiencies with an "X." If additional space is needed, make copies of this page (or use additional blank sheets).

Item Number	*Comments and/or Deficiencies as Noted on the On-Site Assessment - Test Method Review Summary*

APPENDIX D

CALIBRATION REQUIREMENTS

CALIBRATION REQUIREMENTS

Apparatus/Instrumentation	*Calibration/or Verification Frequency*
Acoustic calibration or pistonphones	annually
Balances	annually
Engines-speed tachometers	annually
Filter sets (octave-band and one-third octave-band)	every 2 years
Flowmeters (air)	annually
Frequency analyzers	every 2 years
Frequency counters	annually
Force gauges	annually
Oscillators	annually
Reference microphones	annually
Reference sound sources	annually
(calibration in accordance with ANSI S1.35 or ISO 3745)	every 2 years
Tape recorders or graphics level recorders	annually
Test signal (pink noise) generators	annually
Test signal (pure tone) generators	annually
Timers	annually
Wave-form generators	annually
Hygrometers	semiannually
Temperature	semiannually
Pressure measuring devices (air)	semiannually
Voltmeters (precision)	semiannually
Environmental Chambers	semiannually for ASTM Test Method E756 only
Loudspeakers for ANSI S12.32 or ISO 3742	during each test room qualification
Pick-up transducer systems (generator, amplifier, recorder, etc.)	spot-check prior to each test, full calibration once a year for ASTM Test Method E756 only
Reflectometers	check calibration before each test
Sound measurement systems	check before and after each test series using an acoustical calibrator or piston phone
Sound pressure level meters	same as sound measurement systems

APPENDIX E

INTERLABORATORY PROFICIENCY TEST

ACOUSTICAL TESTING SERVICES LABORATORY ACCREDITATION PROGRAM
PROFICIENCY TESTING PROGRAM - 1992*
ASTM E-90
Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

This report describes the results of the 1992 round of proficiency testing to ASTM E-90, "The Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions." Seven NVLAP laboratories participated in this round.

Summary of Test Method

There are two adjacent reverberation rooms with an opening between them in which a test partition is installed. The test partition can be any type of wall, floor, ceiling or other space-dividing structure. The perimeter of the opening is carefully sealed so that the only significant sound transmission path between the rooms is by way of the test partition. With the test specimen in place, an approximately diffuse sound field is produced in the source room; the average sound pressure level in the source room and the resulting sound pressure level in the receiving room are determined. The sound absorption in the receiving room is then determined.

The sound transmission loss for each frequency is calculated using the following equation:

$$TL = \bar{L}_1 - \bar{L}_2 + 10 \log S - 10 \log A_2$$

TL = transmission loss, dB
$\bar{L}_1$ = average sound pressure level in the source room, dB
$\bar{L}_2$ = average sound pressure level in the receiving room, dB
S = area of test specimen common to both rooms, m^2
A_2 = sound absorption of the receiving room with test specimens in place, metric sabins

The test is performed in the audio frequency range. The data points are taken at one-third octave band frequencies from 100 to 5000 Hz corresponding, roughly, to the range of the human voice.

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*Proficiency testing program conducted by Howard Kingsbury, Acoustical Consultant under contract to NIST/NVLAP, September 1992.

Test Artifact and Test Conditions

The test artifact used in this round of tests was the reference specimen panel described in ASTM E-1289-91, "Standard Specification for Reference Specimen for Sound Transmission Loss." Each laboratory was instructed to follow the step-by-step procedures for constructing the reference specimen contained in the standard. The panels are 24-gauge sheet steel mounted on 25 x 25 x 3.2 mm (1 x 1 x 1/8 inch) angle iron. Mounting conditions in the test opening are described in the standard.

For this series of tests, two sets of panels were used by each of the laboratories. The laboratories conducted two separate tests: 1) single panel transmission loss, and 2) double panel transmission loss with the two panels separated by 20 cm. The first test condition, single panel, is essentially a repeat of the proficiency test conducted in 1987 and provides information on long-term reproducibility for each of the labs. The second test condition, double panel, was used to obtain a higher sound transmission loss and to specify a test condition where the answer had not been previously determined by the laboratories.

Each laboratory was instructed to perform the tests in strict accordance with ASTM E-90.

Test Results

Each laboratory calculated sound transmission loss in decibels, for each of seventeen 1/3 octave center frequencies from 125 to 5000 Hz based on measurements made on the single and double panel test artifacts. Three labs included data for 100 Hz.

In order to maintain confidentiality, the participating laboratories are indicated by a letter of the alphabet (A through G) in the tables and figures. The same letter is used for a given laboratory throughout this report, but it should be noted they are not the same letters as those assigned in the report of the 1987 transmission loss proficiency test.

The test results for the single and double panel tests are shown in tables 1 and 2. The individual test results are the calculated sound transmission loss for each of the 1/3 octave frequencies specified in E-90. The Mean is the arithmetic average of the data for the laboratories at each frequency (across the row) and the SD is the between-laboratory standard deviation. While the transmission loss results are reported to the nearest whole number, the means and standard deviations are calculated to tenths for statistical purposes.

The Sound Transmission Class (STC), the single number expression of sound transmission loss, is calculated in conformance with ASTM E-413, "Classification for Rating Sound Insulation." The STC correlates, in a general way, with the subjective impression of speech privacy in buildings. STCs are widely used as a single number comparison of building partitions; higher STCs indicate improved privacy.

Discussion and Observations

The data from tables 1 and 2 are displayed in graphic form in figures 1 and 2. The graphs display the 1/3 octave frequencies on a logarithmic scale from 100 to 10,000 Hz (x-axis) and transmission loss on a linear scale from 0 to 70 dB (y-axis).

Tables 3 and 4 show the deviation from the Mean, rounded to the nearest whole number, for each laboratory at each frequency for the two test conditions. The number of positive deviations, zero deviations, and negative deviations are shown in the lower part of the tables. For both test conditions, laboratory D has a majority of negative deviations indicating that it is systematically low compared to the

group. For both test conditions, laboratory F has a majority of positive deviations indicating that it is systematically high compared to the group. Tables 3 and 4 are shown graphically in figures 3 and 4, respectively.

Figure 5 is an attempt to look for correlation between the single and double panel tests for each laboratory at each frequency. The data from table 3 are plotted on the x-axis and the data from table 4 are plotted on the y-axis. Except for one point (laboratory D in the lower right quadrant), the data form a tight group. Laboratory D appears mostly in the lower left quadrant, again indicating a systematic low bias, and laboratory F appears mostly in the upper right quadrant, indicating a systematic high bias. The group is elongated in the y-axis due to the greater range (increased variance) among the laboratory test results.

Six of the laboratories in the current round also participated in the 1987 round of proficiency testing. The transmission loss results for the 1987 round and the current round are shown in table 5. For the six laboratories, the STC changed by at most two units between the two rounds. Eighty-four percent of the transmission loss values changed by zero or $\pm$ 1 dB between the two rounds. There was one anomalous change of 6 dB.

Several of the laboratories reported their data to tenths of dB. This should be discouraged, both because Section 11.1.4 of E-90 states specifically that results are to be reported to the nearest decibel, and the results of this test series indicate that reporting to tenths gives an unwarranted implication of precision.

Conclusions

For the single panel test (fig. 3), the range of laboratory results is within 3 dB of the Mean at each frequency. For the double panel test (fig. 4), the range of laboratory results is within 7 dB of the Mean at each frequency. The ranges are relatively uniform across the frequency range for both test conditions. Systematic bias appears to be the main cause of the spread and the uniformity.

The data from six laboratories that tested in 1987 and in 1992 (table 5) indicate that there is long-term stability in the measurements using the reference specimen panel.

The variation in the test results for the double panel test are higher than anticipated. The cause is not known, however minor variations in mounting conditions or panel construction are suspected. It would be desirable for each laboratory to repeat the double panel test to determine within-laboratory repeatability.

Information

For additional information, contact Paul R. Martin, NIST/NVLAP, Bldg. 411 Room A162, Gaithersburg, MD 20899, phone 301-975-3679, FAX 301-926-2884.

Table 1

SINGLE PANEL TRANSMISSION LOSS
1/3 Octave Band TL, dB

	Laboratory Designation								
1/3 OB, Hz	A	B	C	D	E	F	G	Mean	SD
100						12	10	12	
125	13	11	13	12	11	14	12	12.3	1.2
160	15	11	14	12	12	16	13	13.3	1.8
200	16	13	17	12	14	16	14	14.6	1.8
250	16	14	17	13	15	17	17	15.6	1.6
315	18	16	18	15	17	20	18	17.4	1.6
400	19	18	20	16	19	20	19	18.7	1.4
500	21	20	21	18	20	22	21	20.4	1.3
630	22	22	23	20	22	23	23	22.1	1.1
800	24	24	24	21	24	26	25	24.0	1.5
1000	25	26	26	23	25	28	27	25.7	1.6
1250	28	27	27	25	28	30	29	27.7	1.6
1600	30	29	29	28	30	31	30	29.6	1.0
2000	31	31	31	30	31	33	33	31.4	1.1
2500	33	33	32	33	34	35	34	33.4	1.0
3150	34	35	34	34	35	37	36	35.0	1.2
4000	36	36	35	38	37	39	38	37.0	1.4
5000	38	39	37	42	39	41	--	39.3	1.9
STC	25	24	26	23	25	27	26	25	

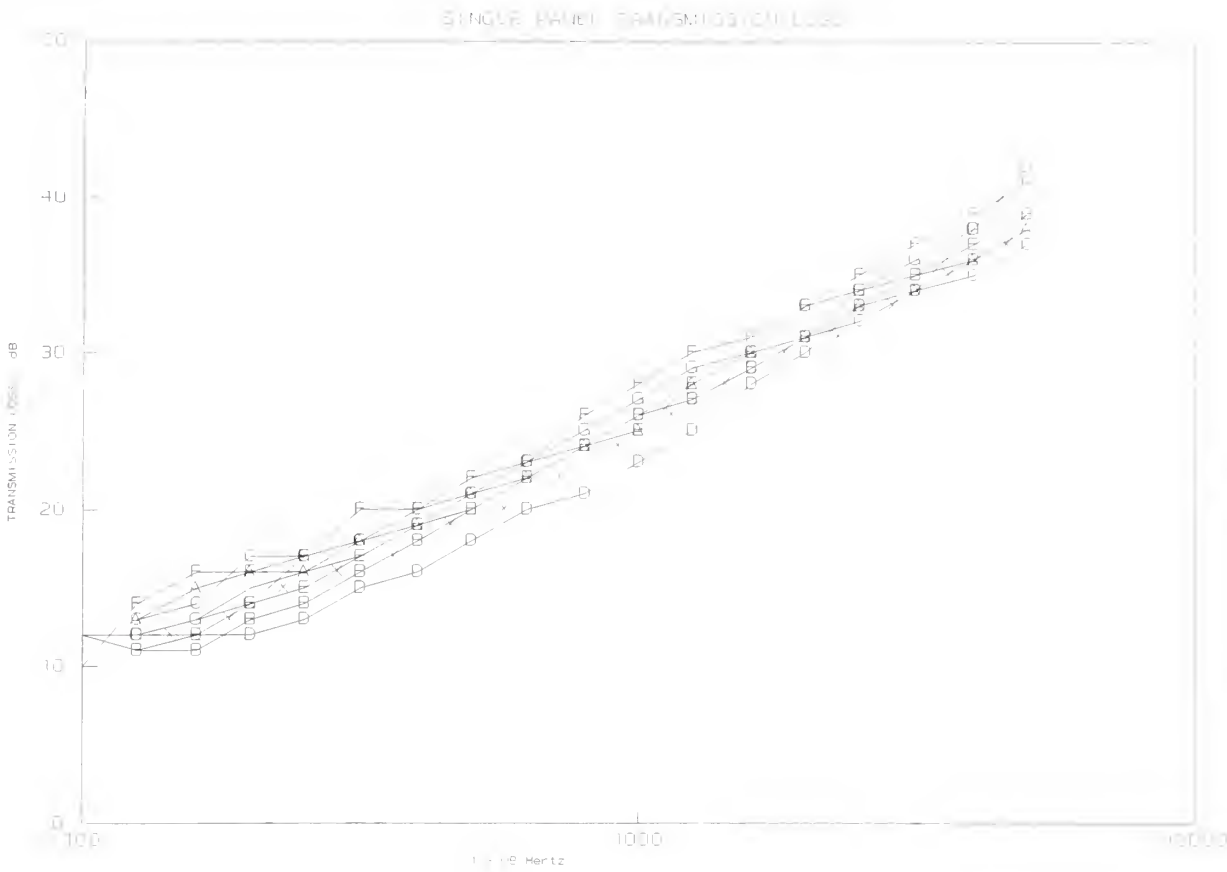

Figure 1

The data from Table 1, for single panel test, are plotted for each laboratory. The data are displayed on a logarithmic scale from 100 to 10,000 Hertz. Each laboratory is shown by a different letter of the alphabet. The group arithmetic average (Mean) has been plotted with the letter X.

Table 2

DOUBLE PANEL TRANSMISSION LOSS
1/3 Octave Band TL, dB

Laboratory Designation

1/3 OB, Hz	A	B	C	D	E	F	G	Mean	SD
100					14	10	13		
125	15	11	12	16	14	16	15	14.1	2.0
160	20	13	15	16	14	17	16	15.9	2.3
200	22	14	18	17	16	18	19	17.9	3.5
250	24	16	21	18	17	23	21	20.0	3.0
315	25	19	27	21	19	25	21	22.4	3.2
400	28	22	27	24	23	25	23	24.6	2.2
500	34	25	30	25	25	29	27	27.9	3.4
630	38	30	35	29	29	32	31	32.0	3.4
800	42	35	40	31	33	36	36	36.1	3.8
1000	42	39	44	33	36	40	40	39.1	3.7
1250	46	43	46	36	42	47	44	43.4	3.7
1600	49	46	48	43	47	51	48	47.4	2.5
2000	52	49	51	46	50	54	51	50.4	2.5
2500	55	52	54	50	54	59	54	54.0	2.8
3150	57	56	57	51	57	61	57	56.6	2.9
4000	59	58	61	55	60	64	59	59.4	2.8
5000	57	60	64	55	63	67	--	61.0	4.5
STC	35	29	33	30	29	33	31	31	

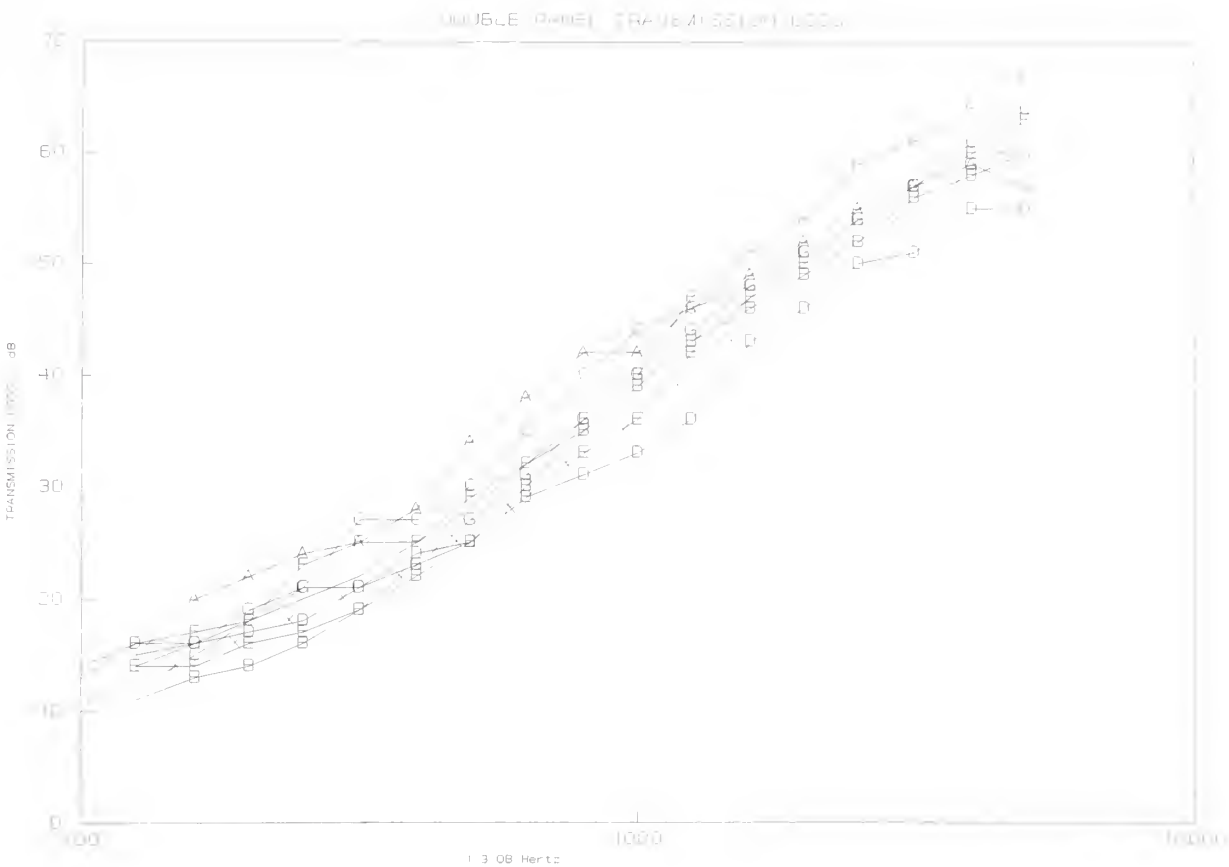

Figure 2

The data from Table 2, for double panel test, are plotted for each laboratory. The data are displayed on a logarithmic scale from 100 to 10,000 Hertz. Each laboratory is shown by a different letter of the alphabet. The group arithmetic average (Mean) has been plotted with the letter X.

Table 3

SINGLE PANEL TRANSMISSION LOSS
DEVIATION FROM GROUP MEAN, TABLE 1
ROUNDED TO WHOLE NUMBERS

1/3 OB, Hz	A	B	C	D	E	F	G
100							
125	1	-1	1	0	-1	2	0
160	2	-2	1	-1	-1	3	0
200	1	-2	2	-3	-1	1	-1
250	0	-2	1	-3	-1	1	1
315	1	-1	1	-2	0	3	1
400	0	-1	1	-3	0	1	0
500	1	0	1	-2	0	2	1
630	0	0	1	-2	0	1	1
800	0	0	0	-3	0	2	1
1000	1	0	0	-3	1	2	1
1250	0	-1	-1	-3	0	2	1
1600	0	-1	-1	-2	0	1	0
2000	0	0	0	-1	0	2	2
2500	0	0	-1	0	1	2	1
3150	-1	0	-1	-1	0	2	1
4000	-1	-1	-2	1	0	2	1
5000	-1	0	-2	3	0	2	--
Count							
+	6	-	8	2	2	17	11
0	8	8	3	2	11	-	4
-	3	9	6	13	4	-	1

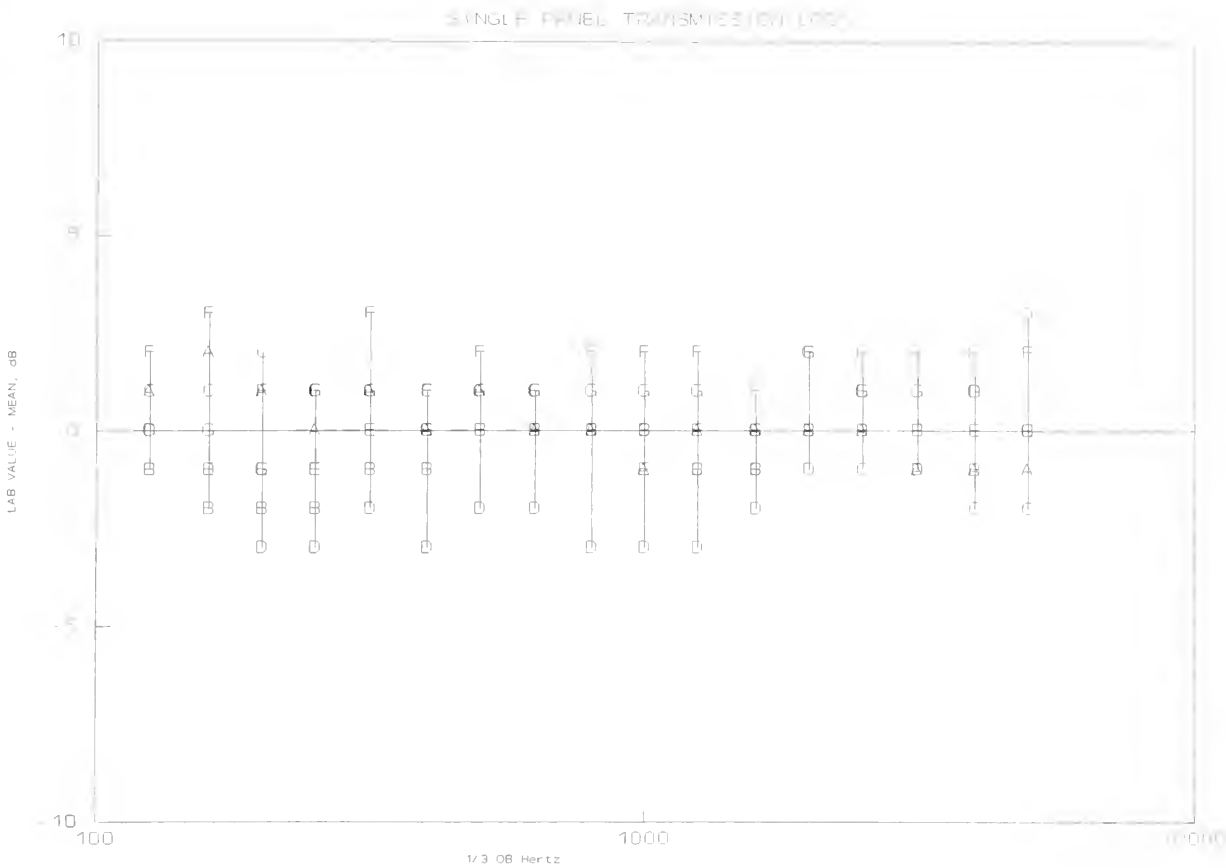

Figure 3

The deviation from the Mean for each frequency in Table 3 are plotted. The mean is set at the zero point along the y-axis and the deviation data at each frequency along the x-axis is plotted. The data for laboratory D shows a low bias and the data for laboratory F shows high bias.

Table 4

DOUBLE PANEL TRANSMISSION LOSS
DEVIATION FROM MEAN, TABLE 2
ROUNDED TO WHOLE NUMBERS

1/3 OB, Hz	A	B	C	D	E	F	G
125	1	-3	-2	2	0	2	1
160	4	-3	-1	0	-2	1	0
200	4	-4	0	-1	-2	0	1
250	4	-4	1	-2	-3	3	1
315	3	-3	5	-1	-3	3	-1
400	3	-3	2	-1	-2	0	-2
500	6	-3	2	-3	-3	1	-1
630	6	-2	3	-3	-3	0	-1
800	7	0	5	-4	-2	1	1
1000	3	0	5	-6	-3	1	1
1250	3	0	3	-7	-1	4	1
1600	2	-1	1	-4	0	4	1
2000	2	-1	1	-4	0	4	1
2500	1	-2	0	-4	0	5	0
3150	0	-1	0	-6	0	4	0
4000	0	-1	2	-4	1	5	0
5000	-4	-1	3	-6	2	6	--
Count							
+	14	-	2	1	2	14	8
0	2	3	3	1	5	3	4
-	1	14	12	15	10	-	4

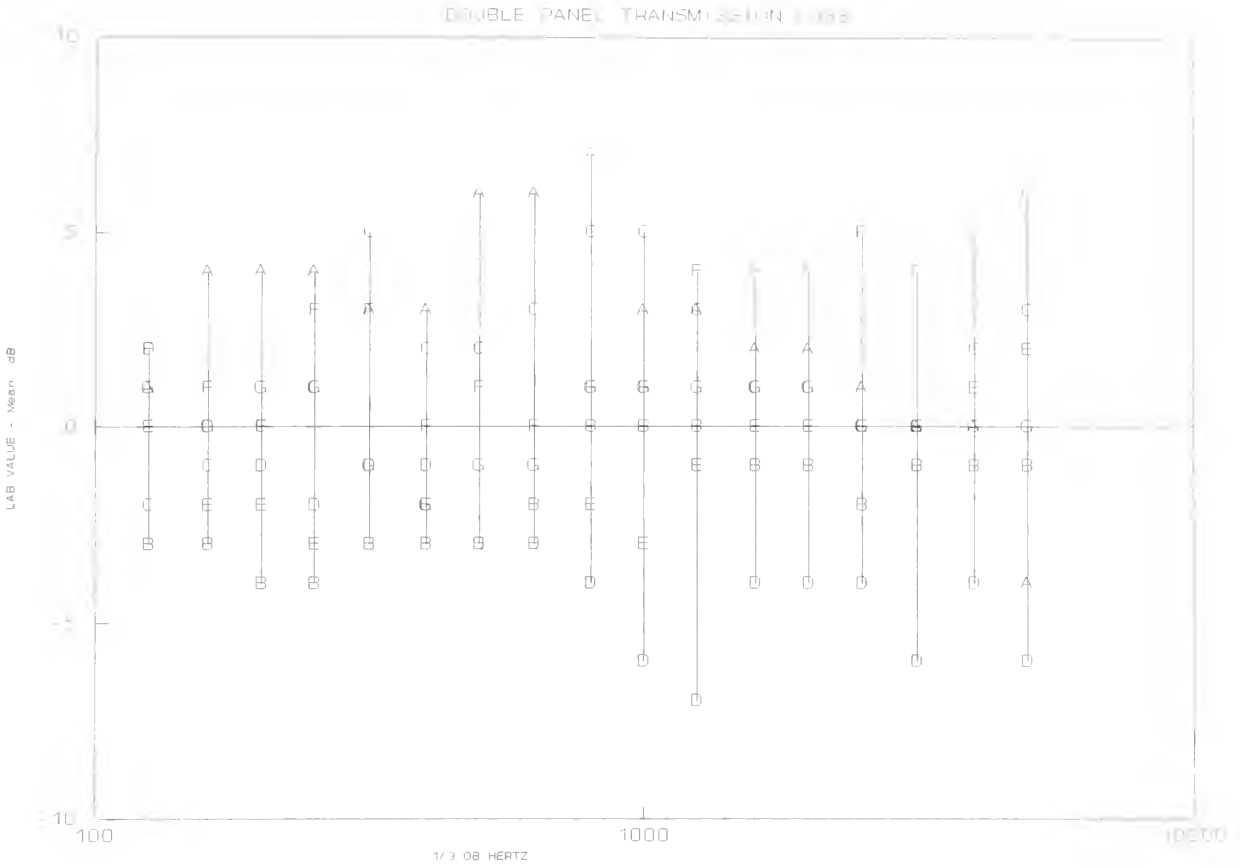

Figure 4

The deviation from the Mean for each frequency in Table 4 are plotted. The mean is set at the zero point along y-axis and the deviation data at frequency along the x-axis is plotted.

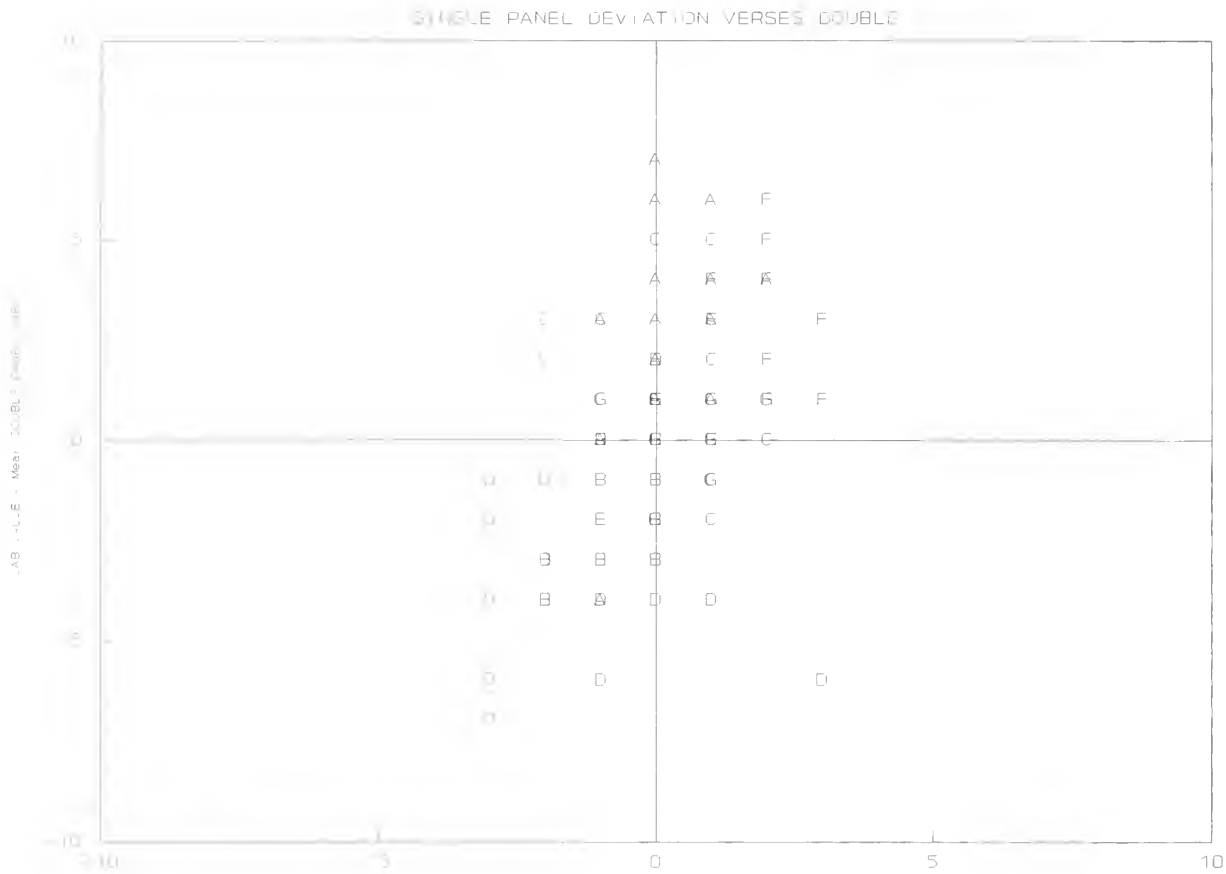

Figure 5

The data from Tables 3 and 4 are plotted together to give an indication of the distribution of the data points for each frequency and laboratory. From the graph above, laboratory D indicates a negative bias and laboratory F indicates a positive bias.

Table 5

COMPARISON OF SINGLE PANEL TL DATA
FROM 1987 AND 1992
PROFICIENCY TESTS
1/3 Octave Band TL, dB

Laboratory Designation

1/3 OB, Hz	A		B		C		D		E		F	
	'87	'92	'87	'92	'87	'92	'87	'92	'87	'92	'87	'92
100												
125	13	13	10	11	14	13	12	12	12	11	14	14
160	13	15	11	11	13	16	12	12	13	12	15	16
200	16	16	13	13	16	17	15	12	15	14	17	16
250	16	16	15	14	17	17	15	13	16	15	18	17
315	17	18	17	16	18	18	16	15	18	17	19	20
400	18	19	19	18	20	20	18	16	21	20	22	22
500	20	21	21	20	21	21	20	18	21	20	22	22
630	22	22	22	22	23	23	22	20	22	22	24	23
800	24	24	24	24	24	24	24	21	25	24	25	26
1000	26	25	26	26	26	26	26	23	26	25	27	28
1250	27	28	28	27	28	27	27	25	29	28	29	30
1600	29	30	30	29	29	29	29	28	31	30	31	31
2000	31	31	32	31	31	31	31	30	33	31	33	33
2500	33	33	33	33	34	32	33	33	34	34	35	35
3150	35	34	35	35	36	34	34	34	35	35	37	37
4000	36	36	36	36	37	35	35	38	37	37	39	39
5000	38	38	38	39	40	39	36	42	38	39	41	41
STC	25	25	25	24	26	26	25	23	26	25	27	27

APPENDIX F

TEST METHOD SELECTION LIST

NVLAP LAB CODE: _____

ACOUSTICAL TESTING SERVICES
TEST METHOD SELECTION LIST

Instructions: Check each test method for which you are requesting accreditation.[1]

	NVLAP Code	*Test Method Designation*	*Short Title*
_____	08/P01	ASTM C367	Strength - Pre-fab arch. acoustic materials
_____	08/P02	ASTM C384	Impedance and absorption of acoustic materials
_____	08/P03	ASTM C423	Sound absorption and absorption coeffs.
_____	08/P04	ASTM C522	Airflow resistance of acoustic materials
_____	08/P05	ASTM C523	Light reflectance of acoustic materials
_____	08/P06	ASTM E90	Airborne sound transmission loss
_____	08/P07	ASTM E492	Impact sound transmission - Floor/ceilings
_____	08/P08	ASTM E596	Noise reduction of isolating enclosures
_____	08/P09	ASTM E756	Vibration damping properties of materials
_____	08/PI0	ANSI S12.31 [2]	Sound power levels - broadband noise
_____	08/P13	ANSI S12.32 [2]	Sound power levels - narrow band noise
_____	08/P17	ISO 3741 [2]	Sound power levels - broadband sources
_____	08/P20	ISO 3742 [2]	Sound power levels - narrow band sources
_____	08/E11	ISO 3744	Sound power levels - noise over refl. plane
_____	08/P21	ISO 3745	Sound power levels - noise in anechoic room
_____	08/P24	ISO 7779 [2]	Airborne noise by computer & business equipment

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[1] Accreditation is limited to the frequency range for which the test room has been qualified.

[2] The following pairs of test methods have been determined by NVLAP to be equivalent:
ANSI S12.31 and ISO 3741
ANSI S12.32 and ISO 3742
ANSI S12.10 and ISO 7779
AMA-1-II-67 and ASTM E1414.

If both test methods in a pair are checked, a laboratory will be charged for only one test method, and both test methods will appear on the scope of accreditation.

_____	08/P25	ANSI S12.10[2]	Noise emitted by computer & business equipment
_____	08/E01	ANSI B71.1 (para. 9 and 21)	Sound levels - mowers & tractors
_____	08/E21	AMA-1-II-67 [2,3]	Ceiling Sound Transmission - two room method
_____	08/P26	ANSI S3.19	Measurement of Real-Ear Protection of Hearing Protectors
_____	08/P27	ANSI S12.6	Measurement of the Real-Ear Attenuation of Hearing Protectors
_____	08/P28	ASTM E1375	Measuring the Interzone Attenuation of Furniture Panels Used as Acoustical Barriers
_____	08/P29	ASTM E1376	Measuring the Interzone Attenuation of Sound Reflected by Wall Finishes and Furniture Panels
_____	08/P30	ASTM E1408	Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems
_____	08/P31	ASTM E336	Airborne Sound Insulation in Buildings
_____	08/P32	ASTM E1007	Tapping Machine Impact Sound Transmission through Floor Ceiling Assemblies
_____	08/P33	ASTM E1111	Measuring the Interzone Attenuation of Ceiling Systems
_____	08/P34	ASTM E1414 [2]	Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
_____	08/P35	ASTM E1050	Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System

_____ Total number of test methods selected for Acoustical Testing Services.

(Enter total on Line 5b of the Fee Calculation Worksheet.)

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[2] The following pairs of test methods have been determined by NVLAP to be equivalent:
ANSI S12.31 and ISO 3741
ANSI S12.32 and ISO 3742
ANSI S12.10 and ISO 7779
AMA-1-II-67 and ASTM E1414.

If both test methods in a pair are checked, a laboratory will be charged for only one test method, and both test methods will appear on the scope of accreditation.

[3] Adopted by the Ceiling and Interior Systems Contractors Association.

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